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International Baccalaureate Science Teachers' Choices in Curriculum and Instruction

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ABSTRACT

This study was designed to investigate the choices International Baccalaureate (IB) science teachers make for Internal Assessment (IA). Data was gathered via a survey of IB science teachers. Their responses were analyzed based upon the teachers' demographics. IB science teachers use a variety of IA activities, with hands-on activities and worksheets being most common. They do not emphasize inquiry although some aspects are included. They prefer to use activities designed by themselves or other teachers.

Key Words

International Baccalaureate, internal assessment, inquiry

Introduction

Increased rigor in curriculum is a continuous focus among researchers, educators, parents, politicians, and the public. Literacy in educational areas such as reading, mathematics, and science is constantly being examined. Although some urge that caution should be used when comparing United States curriculum and practices globally, there is a move “toward a common yardstick.” (Cavanaugh, 2009) In this age of concern for increased rigor, literacy, and the positive social and intellectual development of our students, there is one curricular program that has gained increased recognition as fulfilling many of the aspects deemed essential for a quality program. This program is the International Baccalaureate (IB) program. The International Baccalaureate Organization (IBO) website states,

> “The International Baccalaureate® (IB) is a non-profit educational foundation, motivated by its mission, focused on the student. Our three programmes for students aged 3 to 19 help develop the intellectual, personal, emotional and social skills to live, learn and work in a rapidly globalizing world. Founded in 1968, we currently work with 3,371 schools in 141 countries to develop and offer three challenging programmes to over 1,010,000 students aged 3 to 19 years.” (“About the International Baccalaureate,” n.d.)

Their mission statement is:

> The International Baccalaureate aims to develop inquiring, knowledgeable and caring young people who help to create a better and more peaceful world through intercultural understanding and respect. (International Baccalaureate, 2005-2007, Mission, p. 1)

Currently there are 762 IB diploma high schools in the United States and its territories.

The IB program is a high school diploma program which, along with a core of six subjects, science, mathematics, history, communication arts, fine arts, and foreign language, requires all students to complete three additional components. These include: an extended essay about a research topic of their choice; a theory of knowledge (TOK) class; and a creativity, action, and service (CAS) component where students volunteer in various programs and community activities. Along with the separate TOK class, there are TOK objectives included in each of the six subject areas. IB teachers are encouraged to teach some of the objectives while others are a required part of the tested curriculum. These objectives lend themselves to more open-ended discussions in student inquiry.

IB science includes biology, chemistry, and physics. Curriculum within each group includes: major topics of study; options which explore these topics in more depth; and Internal Assessments (IA). The IA is the practical laboratory work students complete under the direction of their teacher. Students complete between forty and sixty hours of activities which support the topics of the course. At the end of the course students complete a culminating examination which assesses their knowledge of the curriculum area. Part of students' final score is based upon their completion of the IA portion which includes a minimum of two open inquiries.

Support is widespread that students should experience inquiry in science classrooms (Lunetta et al., 2007), although there are disagreements about definitions for inquiry (Asay & Orgill, 2010; Minner, Levy, & Century, 2010) and different styles of inquiry are found in the literature (Asay & Orgill, 2010). One of the aims of the IB program is to "develop inquiring minds" (International Baccalaureate 2005-2007) in students and one of the main focuses of current reform in science education is to integrate inquiry-based practices in science classrooms (National Research Council [NRC], 1996, 2002). This research focuses upon the choices IB science teachers make regarding inquiry. This study was conducted prior to the release of the frameworks for K-12 science (NRC, 2011).

Review of Literature

Rigorous science curriculum has gained increased focus since the No Child Left Behind (NCLB) Act (2002) was signed into law. One component of the act is to provide for the improved academic achievement of students by encouraging educational entities to "develop more rigorous mathematics and science curricula that are aligned with challenging state and local content standards and with the standards expected for postsecondary study in engineering, mathematics, and science” (NCLB, 2002, p. 1643).

“Engaging students in more challenging coursework (that) appears to boost learning and achievement” (Clemmitt, 2006, p. 1) is a goal of both the IB and Advanced Placement (AP) programs. A study by the NRC examined AP and IB programs by focusing on questions about advanced study to gain “improved, research-based understanding of teaching and learning” (Gollub, Bertenthal, Labov, & Curtis, 2002, p. 1). This study relied on materials and testimony from individuals who were officials of the organizations, teachers for the programs, or students in the two programs. There were two areas of emphasis in the study on the consistency of the programs: (a) research on cognition and learning and (b) availability of equal access to the advanced study programs. They reported “frequent inconsistencies” (p. 2) with both programs on cognition and learning research, and limited access to these programs for minorities and students in inner-city and rural schools. An ERIC search found only two studies on IB. One (Talbot, 2000) focused on TOK in science. The other (Mathews and Kitchen, 2007) investigated stakeholders’ impressions of the IB program as a “school within a school” gifted program.

The National Center for Education Statistics, as part of the National Assessment of Educational Progress (NAEP) High School Transcripts Study (2007), showed “high school graduates who took neither AP/IB mathematics courses nor AP/IB science courses earned a lower overall mean GPA than the AP/IB course-taking subgroups” (Perkins, Kleiner, Roey, & Brown, 2004, p. 2). Sadler and Tai (2007) investigated whether it was better for students preparing for college to take an AP course and get a lower grade or take a “regular” course and get an A grade. They found when taking variations in college grading systems into account, there was “strong evidence to support adding bonus points to students’ high school course grades in the sciences, namely, on a 4-point scale, 1 point for AP courses and .5 for honors courses" (p. 5). Colleges assume students' success in the advanced courses predicts success in college courses, especially in mathematics and science.

Achievement levels of students who participated in AP or IB programs have been examined in two empirical studies. The Pfeiffenberger, Zolanda, and Jones (1991) study focused on the dynamics of writing tests for AP physics and examined data from the National Assessment of Educational Progress (NAEP) and the International Assessment of Educational Progress on physics achievement. The discouraging news was that "student performance seldom meets the expectations of the test development committees…and…low rate of participation among women and some minorities" (p. 37). They reported that from 1956-1990 there was an increase in the number of students taking the AP exam but not a significant decrease in the scores on the examination. Poelzer and Feldhusen (1996) noted IB students in all science areas had higher achievement levels on pre and post tests administered than did non-IB students.

There is controversy regarding whether AP or IB courses affect persistence to college graduation or performance in college. Klopfenstein and Thomas (2005) stated, "Our findings suggest that while a rigorous high school curriculum clearly impacts the likelihood of early success in college, AP courses are not a necessary component of a rigorous curriculum" (p. 14). In contrast, Adelman (1999, 2006) concluded that a rigorous high school course load is a factor in college success, with AP courses being one factor that influenced completion of a bachelor's degree. He concluded that "taking at least three Carnegie Units in core laboratory science (biology, chemistry, and physics) is more critical than taking AP classes, even though AP courses contribute to the highest level of academic intensity in a high school curriculum" (2006,

p. 2). The only studies that have examined curriculum taught in high school classrooms have been sponsored by the AP and IB organizations reported on their web sites.

Although discussion regarding rigorous curriculum tends to include both AP and IB, there are distinct differences. Matthews and Hill (2005) noted, “Unlike most AP courses, an IB course does not allow students to skip the final examination without penalty” (p. xii). They described the differences between the two examinations:

> It is one thing for students to prepare for AP examinations in subjects they like and do well in. It is another kind of challenge to prepare for external examinations that cover an entire curriculum, integrate one’s learning in the Theory of Knowledge course, and write an extended essay and perform community service, (p. 102)

alluding to IB as the more challenging of the two programs.

According to Kyburg, Hertberg-Davis, and Callahan (2007), minority IB students believed their teachers knew them on a personal level and were “confident that their teachers possess expert knowledge in their fields” (p. 205). They thought the TOK component of the IB curriculum “especially encourages students to challenge conventional ways of approaching problems or thinking about things, and the required extended essay is one area where students have more latitude to choose topics of personal interest” (p. 205).

There is much autonomy given to teachers in the IB program, allowing them freedom of choice in the types of activities and options for students. Numerous studies have been conducted which examined teachers’ choices and the factors affecting those choices, both generally and specifically in science education (Ackay & Yager, 2010; Aikenhead, 1984; Akinoglu, 2008; Burris, et. al, 2007; Crawford, 2007; Deemer, 2004; Henry, 1994; Ingram, Louis, & Schroeder, 2004; Jones & Carter, 2007; Putnam, 1984; Westerman, 1991). It is well documented that teachers’ choices impact the lives of their students (Coleman & Cross, 2001; Croft, 2003; Lindsey, 1980; Wright, et. al, 1997). Westerman (1991) studied how factors influence expert and novice teachers differently. Henry (1994) reported informal student outcomes and teacher enjoyment as major factors affecting teachers' decisions, while Deemer (2004) focused upon school culture. Ingram et al. (2004) examined how the decisions teachers make are data driven because teachers look at the results on standardized assessments to make some of their decisions. Lunetta, Hofstein, and Clough (2007) noted teachers' decisions are driven by learning outcomes which frequently are determined by high-stakes tests. Also, it was found that teachers' decisions are most influenced by how they were taught and some find it hard to break this mold (Ackay & Yager, 2010; Blanchard et al., 2008 & 2010).

"Individual teachers have substantial leeway in implementing AP and IB courses. Therefore, the nature and quality of instruction may vary considerably from classroom to classroom" (Gollub et al., 2002, p. 10). Studies conducted to probe the relationship between teacher behavior and student learning and achievement found a definite relationship (Brophy, 1979; Burton, et al, 2002; Haycock, 1998; Schroeder et al. 2007; Wenglinsky, 2002; Wright, et al, 1997). Kyburg et al. (2007) listed two key factors which contributed to minority students' academic growth. One of these was teachers providing "scaffolding to support and challenge students" (p. 173). This support included time spent with students before and after school, lunchtime discussion groups, and college visits subsidized by the school. "Differences in teacher effectiveness were found to be the dominant factor affecting student academic gain" (Wright et al., 1997, p. 66).

Inquiry as a curricular component, both inquiry teaching and inquiry by students, has been investigated extensively in science education as an important component of students' learning (Ackay & Yager, 2010; Akinoglu, 2008; Blanchard 2008 & 2010; Crawford, 2007; Forbes & Davis 2010; Kang, Orgill & Crippen, 2008; Lebak & Tinsley, 2010; Wang & Lin, 2008). Fradd and Lee (1999) found that many science teachers have not embraced inquiry as a pedagogical approach due to the complexity of teaching in a nontraditional manner. Alozie, Moje, and Krajcik (2009) found that constraints such as time limited the use of inquiry in the classroom. Blanchard et al. (2010) found constraints imposed by standardized assessments limited inquiry, especially when curriculum supports were not in place. Beyer et al. (2009) showed little support for teachers choosing inquiry and suggested incorporating educative materials for teacher use in their curriculum as better than providing professional development for teachers to promote inquiry.

The standard for what is inquiry has come from *Inquiry and the National Science Education Standards* (NRC, 2000). It identifies classroom inquiry as having five essential components: (a) learner engages in scientifically oriented questions; (b) learner gives priority to evidence in responding to questions; (c) learner formulates explanations from evidence; (d) learner connects explanations to scientific knowledge; and (e) learner communicates and justifies explanations (NRC 2000). In practice there is a continuum of instructional approaches ranging from entirely teacher directed to completely open-ended inquiry (Blanchard et al., 2010).

Purpose

This study's foci included the choices IB science teachers make for IA activities, IA resources, and IA categories. The relationship between teachers' demographics and these choices was examined.

The following research questions were used to gather information on these foci:

<u>Research Question 1</u>: What curricular choices do IB science teachers make related to IA activities?

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<u>Research Question 2</u>: What choices do IB science teachers make regarding the level of use for the different categories of IA?

<u>Research Question 3:</u> To what degree do IB science teachers' courses taught, years of experience (total and IB), level of education, undergraduate major, graduate major, school population, and percentage of students enrolled in IB affect their IA choices?

Methodology

Sample

Fifty-three teachers who responded to the survey had attended either a Level 3 IB conference in Reston, Virginia or a round-table discussion meeting in Kansas City, Missouri. Participants from the Reston conference were initially contacted electronically by International Baccalaureate – North America (IBNA) with a letter introducing the study and asking for their participation. Surveys were e-mailed directly to the teachers who volunteered to participate. Participants from the Kansas City, Missouri round-table discussion were either given a survey on the day of the discussion or received an e-mail. All teachers in the sample were IB science teachers. This sample of teachers included 25 biology teachers, 18 chemistry teachers, and 10 physics teachers.

Design

A survey was selected as the best approach to quickly and easily reach many people in widely scattered areas (Van Dalen, 1966). Schaefer and Dillman (1998) stated that "the cost and speed advantages of e-mail make it ideal for a first mode of contact in surveys" (p. 379). Since the IB science teachers in this study were located throughout North America, ease of reaching many of them in a timely fashion was essential. Participants in this study were given the choice as to whether they wanted the survey sent by regular mail or as an e-mail attachment. All 40 Reston participants preferred receiving and responding to their survey through e-mail. Eight (62%) of the Kansas City participants completed the survey at the roundtable discussion; the rest returned the survey electronically.

An initial survey was designed and then piloted with 12 individuals to determine whether the format and style of the survey were appropriate. Respondents made comments about improvements, areas where clarification was needed, or additions they would suggest. The survey was revised based upon suggestions from the pilot and a panel of science educators to provide validity.

This survey was designed to ascertain information from IB science (biology, chemistry, and physics) teachers related to their IB curriculum in the areas of resources for IA, areas of emphasis for IA, and types of IA activities. Items for the list of IA activities came from activities listed in various IBO publications including curriculum guides and the National Survey of Science and Mathematics Education (Weiss, Banilower, McMahon, & Smith, 2001). The 2006-2007 and 2007-2008 school years provided the data about these choices. During this time a major curriculum change occurred. This curriculum change involved renaming the categories by which students were assessed on their IA's and changing the focus of the mark schemes to be focused on inquiry design, data collection and processing instead of the general planning A and B categories which existed before.

Science teachers recorded their frequency levels for the different IA categories. For the 2006-2007 school year choices for these categories included: Planning A, Planning B, Data Collection, Data Processing and Presentation, and Conclusion and Evaluation. Planning A and B included aspects of design including a research question, hypothesis, materials and procedure written by the student. For the 2007-2008 school years these choices included: Design, Data Collection and Processing, and Conclusion and Evaluation. IB teachers are expected to do a minimum of two activities in each of these categories during the total implementation of the course but may do more. Categories for frequency levels identified on the survey were: Minimum (2 IA's only), Rarely (3-6 IA's), Sometimes (7-12 IA's), and Often (more than 12 IA's). The category Conclusion and Evaluation was the same for both 2006-2007 and 2007-2008 so teachers responded only once for this category.

The survey included a section which asked participants to record the number of times different activities on a list were used in their IA for one school year. They could also record additional activities not listed. Subsequently, a scale allowed teachers to identify the number of times they used particular resources from the list. Section II also requested teachers to identify the frequency they used the different categories of IA. The demographics section identified experience for both total teaching and IB teaching, undergraduate major, advanced degree, advanced degree major, type and size of school where they teach, percentage of students enrolled in IB at the school, and any further comments.

Surveys were e-mailed to IB science conference participants or given directly to roundtable attendees who agreed to participate in the study. In addition to the survey, a letter of introduction and suggested reply deadline were provided. Participants were given two weeks to return the survey. After those two weeks, a follow-up e-mail was sent to all non-respondents.

Data Analysis

Descriptive statistics were calculated for demographics: science course taught, total number of years teaching, number of years IB teaching experience, undergraduate major, highest earned degree, graduate major, total school population, and percent of students enrolled in IB.

Pearson's product-moment correlations and linear regression values were computed as tests of statistical significance of the three research questions.

Results

Demographics

Demographic information was used to determine the factors which affected IB science teachers' choices for curriculum and instruction. Twenty-five (47%) respondents taught biology, 18 (34%) taught chemistry, and 10 (19%) taught physics. The mean total years of teaching experience were 15.8 (*SD* = 15.8). Forty-four teachers (85%) held a master's degree or higher. Forty-three (81.1%) teachers held an undergraduate major in a science field. Their graduate majors were in education for 26 respondents (50%). The mean value for the population of students in the schools where they taught was 1688.2 (*SD* = 663.04). The mean percentage for students enrolled in IB was 21.57% (*SD* = 22.74).

Internal Assessment

Internal Assessment

Table 1 summarizes the means and standard deviations for all teachers' IA activity use. Hands-on activities and worksheets had means of 23.11 (*SD* = 19.10) and 22.73 (*SD* = 26.18) respectively. Recording or presenting data had a mean of 15.41 (*SD* = 16.83) and graphical analysis had a mean of 10.79 (*SD* = 10.69). The mean for graph development averaged 9.72 (*SD* = 9.84), while students' design experiments and data logging had similar means, 4.17 (*SD* = 3.05) and 4.15 (*SD* = 6.07) respectively. The IA activities which had the lowest level of use were field trips and collaboration with professionals.

Table 1: Means and Standard Deviations for Times IA Activities Chosen by Sample Teachers (*n* = 52)

IA Activities for 2007-2008	M	SD
Database analysis	2.06	4.57
Data logging	4.15	6.07
Graphical analysis	10.79	10.69
Graph development	9.72	9.84
Simulations	3.30	3.66
Hands-on activities	23.11	19.10
Student written investigations	8.74	10.37
Participation in field work	1.64	3.84
Worksheets	22.73	26.18
Literature research	2.40	2.64
Model building	2.06	3.22
Group projects	4.09	5.26
Spreadsheet analysis on computer	1.28	2.00
Record or present data	15.41	16.83
Audio/visual presentations	5.56	13.91
Students design experiments	4.17	3.05
Collaboration with professionals	.43	1.15
Field trips	.90	1.13

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The significant relationships listed in Table 2 for linear regression occurred when science course taught was the independent variable and the IA activities data logging, graphical analysis, graph development, participation in field work, literature research, and spreadsheet analysis on the computer were dependent variables. Significant relationships were also shown between years of IB teaching experience and collaboration with professionals. Graduate major as an independent variable showed a significant relationship with the IA activity record and present data.

Table 2: Linear Regression Data IA Activities as the Dependent Variable and Demographics as the Independent Variables (*n*= 52)

Dependent Variable IA Activity	*Independent Variable Demographic*	R^2	B	SE B	Beta	p
Data logging	Science course	.235	3.250	1.057	.403	.004
Graphical analysis		.100	-4.715	2.081	-.317	.028
Graph development		.124	-4.793	1.878	-.352	.014
Participation in field work		.103	-1.727	.750	-.322	.026
Literature research		.088	-.988	.470	-.296	.041
Spreadsheet analysis on a computer		.229	.841	.353	.313	.022

Collaboration with professionals	IB teaching experience	.156	-.080	.039	-.285	.046
Record & present data	Graduate major	.082	-4.338	2.027	-.287	.037

Table 3 shows categories for Data Collection (2001), Data Processing and Presentation (2001), Data Collection and Processing (2007) and Conclusion and Evaluation (2001 & 2007) were used at the level "Sometimes" indicating these categories were used 7-12 times for IA's during 2007-2008 by most teachers. "Minimum" was the most frequently chosen level of use for Planning A (2001), Planning B (2001), and Design (2007), indicating these categories were used two times during the school year. The level "Never" was chosen by 12 teachers (22.6%) for the category, Design. This may be due to the fact that this category was new to the IB curriculum in 2007-2008.

Table 3: Frequency and Percentage of the IA Categories' Levels Chosen From the 2001 & 2007 Curriculum Guides in 2007-2008 (*n* = 53)

	Never		Minimum		Rarely		Sometimes		Often	
IA Category	n	%	n	%	n	%	n	%	n	%
2001										
Planning A	1	1.9	5	9.4	30	56.6	12	22.6	5	9.4
Planning B	1	1.9	5	9.4	30	56.6	13	24.5	2	7.5
Data Collection	4	7.5	2	3.8	4	7.5	16	30.2	27	50.9
Data Processing & Presentation	4	7.5	2	3.8	5	9.4	17	32.1	25	47.2

2007										
Design	12	22.6	5	9.4	28	52.8	6	11.3	2	3.8
Data Collection & Processing	6	11.3	2	3.8	4	7.5	17	32.1	24	45.3
2001 & 2007										
Conclusion & Evaluation	0	0	3	5.7	10	18.9	17	32.1	23	43.4

Pearson's product-moment correlations were found between 2001 IA category Planning B with years of IB experience (r = -.290) and 2001 IA category Data Collection with graduate major (r = -.280). Regression analysis with IA categories as the dependent variable and demographics as the independent variable revealed no relationships (Table 4).

Table 4: Pearson's Product-Moment Correlation Coefficient (r) Different IA Categories and Demographics (n = 53, n^a = 48)

	Demographic Variables							
IA Category	Science Course	Total Years Exp.	IB Years Exp.	Highest Earned Degree	Under-graduate Major	Grad. Major	Total School Pop.	IB Enroll %[a]
2001								
Planning A	-.126	.012	-.201	-.044	.044	-.022	-.002	-.209
Planning B	-.079	-.018	-.290*	.032	.034	-.128	.016	-.226

Data Collection	-.010	-.040	-.053	.059	-.050	-.280*	-.141	.139
Data Processing and Presentation	-.043	-.017	.031	-.101	.086	-.120	-.019	-.043
2007								
Design	-.007	-.024	.189	-.155	.206	.202	.000	-.027
Data Collection & Process	-.056	.147	.043	-.086	.015	.049	-.003	-.075
2001& 2007								
Conclusion & Evaluation	-.218	.004	-.097	-.013	.070	-.175	-.054	-.160

*$p < .05$

Conclusions

There was variety related to the IA activities that IB science teachers used in instruction. The predominant activities used were hands-on activities and worksheets. Several individual teachers reported that they used these IA activities at least 100 times during the year. Only two of the activities were used very little on the average: collaboration with professionals and field trips. Budget constraints experienced by schools in recent years may help to explain why these activities are done less frequently when considering their effectiveness for increased student learning.

Inquiry is not a great emphasis among IB science teachers. The only components of inquiry being utilized were found in the IA categories Planning A, Planning B, and Design. The primary levels of uses for these categories were “rarely” or “sometimes.” There is some emphasis among IB science teachers on Data Collection and Processing, which are important aspects of inquiry listed in NSTA's inquiry position statement (NSTA, 2004).

Teachers who cited reasons related to experience and background such as "I was successful with this last year," supported Aikenhead's (1984) conclusion that teachers may draw upon instructional resources such as last year's lesson plans and their own experiences to make "holistic" decisions which integrated science with practical knowledge. Similarly, Henry (1994) noted that informal student outcomes, teacher enjoyment, and teacher compatibility were some of the most prevalent reasons teachers utilize for making curricular choices. This supports Doyle and Ponder (1977-78) who noted that teachers base their decision making on practicality which is affected by three criteria: instrumentality, congruence, and cost.

Hands-on activities as the most frequently used IA activity supports Van den Berg, Katu, and Lunetta (1994), who proposed that when teaching circuits to high school students, hands-on activities were effective for modeling what was involved in circuits. They also found hands-on activities alone were ineffective in teaching all of the scientific relationships required for a complete understanding of circuits. It is important to note this study found that simulations had one of the lowest usage means for IA activities.

Lunetta (1998) proposed that the number of hands-on activities should not be the predominant factor affecting science learning. He considered it to be better for students to do a few "authentic" activities than to do many which are superficial. He recommends to encourage students in minds-on as well as hands-on activities, which is influenced by factors such as cost and safety (Lunetta et al., 2007).

Worksheets were the second-most used activity for IA's. This could mean IB science teachers understand and utilize the ideas suggested by NCR (2006) that when the goal for instruction was student mastery of subject matter, other forms of science instruction could be just as effective as laboratory activities. Weiss, Pasley, Smith, Banilower, and Heck (2003) in their *Inside the Classroom* proposed that the "quality of lessons did not depend on whether the teacher used a 'reform-oriented' approach or a traditional approach. Some lessons judged to be effective were traditional in nature, using lectures and worksheets" (p. 24).

Since worksheets were identified as one of the most prominent IA activities, this seems to indicate IB teachers are limiting authentic laboratory experiences (Hawkes, 2004). Activities like students' design experiments and participation in field work were considerably lower in frequency than worksheets. Although data collection and data processing were some of the most frequently used categories for IA's, the design category was significantly lower. It is not known how students are directed to collect data, but it may be after the teacher directs students to collect certain data or ask students to complete "cookbook" laboratories. If so, this does not allow students "to identify and ask appropriate questions that can be answered through scientific investigations" (NSTA, 2004, p. 2) or become involved in laboratory processes and developing safe and conscientious laboratory practices (NSTA, 2007).

Hofstein and Lunetta (2004) cautioned that although it is important to use laboratory activities in instruction, inquiry alone is not sufficient to assure students achieve a complete understanding of science. Coulter (1966) found that inductive laboratory approaches were not only just as effective as a deductive approach for student instruction and success, but they also were better suited to teaching cause and effect relationships and making judgments after examining evidence. Gardiner and Farregher (1997) found that even when the laboratory activities performed by students were qualitative and confirmatory and less than those required by the course outline, students still were able to answer laboratory-based questions on exams.

Inquiry is not a major emphasis among the IB science teachers participating in this study even though the IB mission states it is important. One possible reason for this may be that IB science teachers do not have the pedagogical content knowledge necessary to be comfortable choosing to include more inquiry in their curriculum, or they feel that inquiry will take time away from preparing for the IB examinations (Wood, 2002). Blanchard et al. (2010) state, “Findings suggest that inquiry methods and high-stakes test performance are not incompatible” (p. 609).

Currently this issue is dealt with as IBO modifies students’ scores on IA’s and encourages increased inquiry. This is not enough. If teachers are uncomfortable and unprepared to incorporate inquiry into their curriculum and instruction, then credentials for IB teachers may need to include that teachers have the ability, desire, or support to use inquiry. Professional development regarding what inquiry is and how to use it can be provided for IB teachers or materials be provided which help teachers learn how to incorporate inquiry into their instructional practices (Beyer et al., 2009; Wood, 2002).

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Self-Directed Learning Practices of Caucasian and African-American Community Members: Do Races Differ?

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Abstract

Self-directed learning is a concept in the study of adult education that explores and explains how individual's go about managing their own learning. During on a sample of over 200 community members in a mid-western community, the self-directed learning practices of these individuals were identified and compared based on self-reported racial identities. Multiple significant differences were identified in the sample between Caucasian and African-American community members, particularly in the use of reading-based self-directed learning practices.

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Introduction

Lifelong learning is a critical element in determining an individual's quality of life (Ballard & Morris, 2003). When individuals engage in learning activities, whether formal or informal, they increase their potential to contribute to their communities, more greatly appreciate the world around them, and even improve their prospects for employment and career mobility. Communities with higher education levels also report greater economic sustainability, lower crime rates, lower birth and divorce rates, and a higher satisfaction with a quality of life. The conclusion to be drawn from data such as these is that it is desirable for communities to appreciate and encourage lifelong learning for both individual and community member benefits.

There are multiple ways that individuals can focus their energies on improving their knowledge and skills, ranging from formal classes and certification programs to activities as simple as reading a book about how to be a better gardener or watching Youtube videos on home repair. These practices that are fully at the discretion of the individual have been defined broadly as 'self-directed learning,' meaning that the individual has control of what is learned and how the individual learns it. The breadth and depth of the instruction, then, is determined only by the individual's interest and self-perceived need or urgency.

How individuals go about directing their learning can have a great impact on a community, as social interactions during self-directed study can impact a community's cohesiveness, can encourage and support others in a social network, and can even help create a community's expectation of community members (community pride, respect for others, expectation of attending school or postsecondary education, etc.). Further, subpopulations within a community are important to understand, particularly how individuals who make an effort to engage in their communities go about learning and advancing their own personal knowledge and skills. This type of role-modeling behavior has important implications for many subpopulations that may have challenges, including the lack of formal education, employment persistence, etc.

The purpose for conducting the current study was to explore how individuals engage in self-directed learning in informal settings, and how these practices differ among races. A key to the study is that self-directed learning was specifically tied to leisure pursuits, that is, those who participated in the study were involved in leisure organizations, those clubs, societies, and organizations that advanced and supported leisure pursuits. By identifying how individuals use SDL practices, and differ in their use, education providers ranging from community colleges to libraries or non-profit organizations can better target the resources they provide to their communities and can invest their resources more effectively and efficiently to help segments of the population meet their intellectual, and subsequently cultural and social, needs.

Background of the Study

Subpopulation research is an important element in understanding a society, and the differences of subpopulations can help explain cultural and regional differences, predict trends, and even potentially impact the quality of citizen life (see Gohn & Albin, 2006 for a discussion of subpopulations). Specifically, how and why individuals engage in improving themselves is important to understand, and much research has gone into elements of self-improvement such as why individuals enroll in college (Choy, 2002), why certain careers or occupations are selected (Dick & Rallis, 1991), decisions to marry, where to live (Rapaille, 2007), and even why individuals participate in leisure activities (Candy, 1991). Generally accepted is that as individuals engage in their communities and participate in organizations and societies that benefit them, these same individuals report greater satisfaction with life and are subsequently less likely to have unhealthy lifestyles, participate in crime, etc.

The nature of subpopulations is that they combine in a collective to form a community; a defined place or combination of individuals and values and norms that represent some commonality. The most common forms of communities are geographically bound (towns, cities, villages, neighborhoods), although virtual communities have grown in popularity and use as a tool to build social support networks. Within a given community, there are groupings of beliefs and values that can arise and work to define that community. Examples include towns with industrial, blue-collar roots, such as Pennsylvania coal mining towns, or towns that grew out of manufacturing plant locations. These beliefs or tendencies of a town can then emerge as common expectations, and these expectations can grow to become community-level expectations, meaning that a community has the potential power to influence individual behavior. Deggs and Miller (2011) identified carriers of these expectations to include informal associations, religious affiliations, civic agencies, home life, and formal education bodies.

Central to the study are the differences in behaviors and expectations between racial subpopulations. Research consistently demonstrates a difficulty in generalizing to entire racial populations, yet there have been significant findings that do highlight differences among races. Williams, Yu, Jackson, and Anderson (1997) identified many similarities among races in terms of health, social class standing, and perceived discrimination when adjusted for education and income, yet, when not adjusting for education level or earnings, African Americans were found to have more health related problems, perceive themselves to be discriminated against, and have poorer levels of mental health and higher levels of stress.

Chauhan, Reppucci, and Turkheimer (2009) similarly found income and education to be important variables in looking at racial differences in neighborhoods, and identified racial differences among African Americans and Caucasians in terms of exposure to violence and criminal recidivism. Yet other research has struggled to isolate race-based differences, noting that generalizing among entire racial groupings is problematic for a variety of reasons, including income and resource distribution, education levels, and questions of accessibility to resources (Garcia, Broad, Frenn, Coviak, Pender, & Ronis, 2009).

In the current study, adult subpopulations are studied in relation to their involvement in self-directed learning. Self-directed learning (SDL) at one point in time was considered the "chief growth area in the field of adult education" (Brookfield, p. 59), and has been heavily studied (Clinton & Rieber, 2010). SDL is often divided into two segments, including self-direction with no instructors (such as deciding to read a book about how to repair a wall), to assisted autodidaxy, where there are instructors who provide learning opportunities, and even grades, but the learner participates at completely based on self-discretion (Clinton & Rieber, 2010). SDL has become popular in collegiate instruction (Hughes & Berry, 2011), and in applied adult learning settings (Chu & Tsai, 2009; Lai, 2011). A fundamental key to SDL in all of these settings is that the participating adult establishes learning objectives and priorities, and must provide the self-determination or motivation to complete the learning tasks. Additionally, SDL can be fluid and increase or decrease in intensity and over time based on the personal needs of the participant (Butcher & Summer, 2011).

Research Methods

Data were collected during the summer and fall of 2012 using a research-team developed survey instrument. The instrument contained three sections: information about the community organization, information about the individual, and a self-rating of frequency of self-directed learning practice use. The survey was based on the literature of self-directed learning and adult education, and was pilot and field tested prior to administration. The instrument was revised and modified after each pre-administration test, and a field test of the instrument with study non-participants yielded a Cronbach reliability index of .7000.

The survey was administered to a total of 16 community organizations that were identified in one community's directory of civic organizations. These organizations were all considered to be "special interest," ranging from a knitting club where participants gather to share strategies about knitting, learn from and support each other, and share each other's work, to a neighborhood hobby club, where neighbors gathered to ride their motorcycles, dialogue about care for their motorcycles, and plan riding time together. The organizations all agreed to allow their membership to be surveyed, and it should be cautioned that all of the organizations had fluid membership and few rules or regulations about attendance and participation.

Surveys were primarily administered in a physical, paper-based format, but for five organizations, an online version of the survey using Qualtrics was administered. A total of 236 surveys were returned for data analysis, and germane to the current study, 219 usable surveys were included in the data analysis. As shown in Tables 1 and 2, not all respondents completed all items on the survey, and only those surveys that self-identified as "Caucasian" or "African American" (n=219) were used in data analysis.

Findings

Of the self-directed learning practices, 36% of the 22 items, eight SDL practices, had significantly different mean ratings of use. Six of the differences were significantly higher for Caucasian respondents, and the remaining two were significantly higher for the African

American respondents. For the Caucasian respondents, they had an overall mean rating of use of these practices of 3.03 on the five-point Likert-type scale of 1=Never Use through 5=Always Use. The practices for Caucasians was distributed, as shown in Table 2, with three practices rated between 4.0 and 5.0, nine between 3.0 and 3.9, seven between 2.0 and 2.9, and three below 2.0. African American respondents had an overall mean rating for the 22 practices of 2.90, with a distribution of 13 items with mean ratings of use between 3.0 and 3.9, six between 2.0 and 2.9 and three below 2.0. For the African American respondents, there were no overall mean responses between 4.0 and 5.0

The most frequently used self-directed learning practice for the entire population was "purchased books to read" (mean 4.03), which was also the most commonly used practice for Caucasian respondents (mean 4.26, but 3.68 for African American respondents). The most commonly used practice for African Americans was "purchased specialized equipment" (mean 3.88; 3.92 for Caucasians).

Of the eight statistical significant differences, Caucasian respondents indicated that they were more likely to use the self-directed learning practices of subscribing to a magazine, purchasing a book to read, reading online blog posts, reading books from the library, reading newspaper articles, and participating in social media (see Table 2). African American respondents reported being significantly more likely to watch a television program related to their interest and participate in informal group discussions.

Discussion

The statistically significant differences identified in the study suggest that those Caucasian community members who engage in self-directed learning are decidedly more likely to use reading-based practices. Not only was African-American engagement in reading-based practices significantly less than that of their counter-parts, use of social media amongst Caucasians was higher as well. There appears to be a reasonable correlation between higher reading-based practices, social media participation, and library use among Caucasian respondents. Historically, African-Americans have lacked or been limited in educational resources and access to activities that perpetuate formal education in comparison to Caucasians. The same could be said about self-directed learning.

The practices included in the survey could be used for purposes of obtaining formal education as well as participating in self-directed learning activities. Considering historical and cultural perspectives, it is not atypical for African-Americans to tend to cater to social environments and involvements like societal groups, fraternal organizations, and perhaps most notably, church, as means to learn and be involved in the community. Church has served African-Americans as a social haven for informal learning and avenue for direction. With some exceptions, African-American respondents demonstrated tendencies to participate more heavily in areas that required more socialization or use items that are commonly used as sources for entertainment, including watching online videos, television programs, participation in group discussions (formal and informal), and attending local and national conferences.

Caucasian respondents using literature as a means to educate themselves should not be surprising as they consistently demonstrate higher educational attainment rates than minorities. Reading based practices function as replacements for formal learning and training environments regardless if it is mere hobby, engaging in intellectual literary discussion, i.e. online blog posts, or achieving an educational objective or goal, e.g. reading a certain number of books in a particular time period or learning how to perform in order to teach at a community center.

The age of the majority of respondents was between age groups of 56 to 70 and 40 to 55. The data suggest that older individuals tend to participate in self-directed learning activities more than younger people. Understandably, younger people, in this case those under 40, may be in school or heavily involved in their respective careers. Given that early retirement usually begins around age 55 and regular retirement begins roughly at age 65, it is conceivable that respondents between ages 56 to 70 as well as 40 to 55, respectively, would seek to participate in activities that contribute to the improvement of their personal welfare.

As an exploratory study, there are limitations to the current investigation, including sample size, geographic location of the study, instrumentation, and even the reliance on the self-reporting to demographic variables. These limitations provide caution in generalizing study findings, but also provide a strong rationale for replication of the study in different urban and rural areas, with different subpopulations, and even with types of adult organizations. And, despite the limitations of the study, the exploratory nature of the investigation provides a highly valuable first step in looking at SDL among different subpopulations in informal settings.

Study findings also have an application to the providers of informal education at the community level. For example, findings might help determine which instructional methods to use, and at the very least, should give instructional designers and teachers an element to consider as educational programs are designed (eg, how to best teach a given course based on learner preferences). Findings might also be applied to exploring the success of given programs, and might be appropriate to consider when and how students are recruited into certain programs, specifically, emphasizing the use of certain SDL strategies available might positive impact the recruitment of learners into a course or to use a facility, such as a library.

Motivations for self-directed learning are linked to the need or desire to self-improve, and although this can be both formal or informal, the current study has primary relevance to informal learning outside of formal educational agencies. The manner of approach for self-directed learning was distinctive between respondents groups. Caucasians clearly tend to read more in order to gain levels of improvement and African Americans are prone to use other methods like discussion and acquiring special equipment to execute their interest. Which is more effective is certainly debatable because various learning strategies are employed in formal education settings and increasingly viewed as necessary to achieve optimal education success. More important are the reasons that each group of respondents choose to indulge in certain types of practices over others is left for future research.

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Table 1.
Characteristics of Survey Respondents

	N	Percentage
Gender		
Male	117	51.0%
Female	112	48.9
Age Range		
Under 40	17	7.4
40-55	60	26.20
56-70	117	51.09
Over 70	35	15.28
Racial Self-Described Identity		
African American/Black	83	36.24
Asian/Pacific Islander	0	0
Caucasian/White	136	59.38
Multi-Ethnic/Other	2	1
Did not answer	16	6
Community Involvement Level		
Very involved	31	13.5
Somewhat involved	119	51.9
Not involved	79	34.49
Held Leadership position in community organization		
Yes	75	32.75
No	154	67.24

Table 2.
Self-Directed Learning Practices Among Community Member Respondents

Sig.	Caucasian	Afr-Am	Overall	
	n=136	n=83	Mean	
Purchased specialized equipment	3.92	3.88	3.90	.342
Visited/studied websites	4.02	3.74	3.91	.110
Subscribed to a magazine	4.11	3.66	3.94	.023*
Purchased books to read	4.26	3.68	4.03	.014*
Watched online videos	3.41	3.60	3.48	.891
Attended public lectures	3.97	3.25	3.69	.047
Interviewed others active in my interest area	3.20	3.19	3.19	.731
Participated in a formal workshop/seminar	3.22	3.20	3.21	.667
Read online blog posts	3.98	3.13	3.65	.024*
Watched related television program	3.12	3.87	3.40	.030*
Subscribed to a newsletter	3.04	3.07	3.05	.888
Participated – informal group discussions	2.85	3.74	3.18	.001*
Read books from the library	2.90	2.11	2.59	.025*
Participated – formal group discussions	2.80	3.15	2.92	.436
Participated in a local conference	2.65	2.70	2.66	.529
Read newspaper articles	3.00	2.42	2.78	.011*
Used/participated in social media	2.64	2.04	2.41	.021*
Read online newspapers	2.51	2.10	2.35	.398
Purchased educational video	2.15	2.08	2.11	.627
Subscribed to a listserv	1.52	1.57	1.53	.344
Participated in a national conference	1.90	1.99	1.93	.871
Took a class for credit	1.54	1.55	1.54	.777